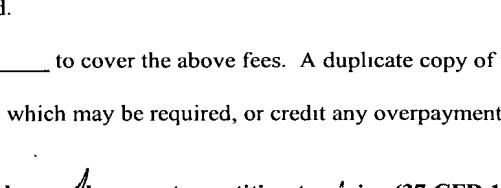


FORM PTO-1350 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE <b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>		ATTORNEY DOCKET NUMBER <b>LSP-0015</b>
		U.S. APPLICATION NO. (if known see 37 C.F.R. 1.5) <b>10/048095</b>
INTERNATIONAL APPLICATION NO. <b>PCT/EP00/07152</b>	INTERNATIONAL FILING DATE <b>26 July 2000</b>	PRIORITY DATE CLAIMED <b>29 July 1999</b>
<b>TITLE OF INVENTION METHOD FOR POWER OPTIMIZATION IN A VEHICLE/TRAIN HAVING AN EFFICIENCY THAT DEPENDS ON THE OPERATING POINT</b>		
<b>APPLICANT(S) FOR DO/EO/US Franke RUDIGER, Peter TERWIESCH, Markus MEYER, Christian KLOSE and Karl-Hermann KETTELER</b>		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1). 4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)). a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) 6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)). 7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input checked="" type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input type="checkbox"/> An oath or declaration of the inventor(s) 35 U.S.C. 371(c)(4). 10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).  <b>Items 11. to 16. below concern other document(s) or information included:</b> 11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 13. <input type="checkbox"/> A <b>FIRST</b> preliminary amendment. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment. 14. <input type="checkbox"/> A substitute specification. 15. <input type="checkbox"/> A change of power of attorney and/or address letter. 16. <input checked="" type="checkbox"/> Other items or information: - A copy of the Published PCT Application by WIPO under No. WO 01/08959, including the search report. - A copy of the International Preliminary Examination report, including amended claims 1 and 2 under Article 34. - An English translation of the Response to the Written Opinion.		
EXPRESS MAIL Mailing Label No. <b>EL 899365916 US</b> Date of Deposit: <b>24 January 2002</b>		
<b>EL 899365916 US</b>		

U.S. APPLICATION NO. (known as Serial No.) <b>10/048095</b>		INTERNATIONAL APPLICATION NO. PCT/EP00/07152	ATTORNEY DOCKET NUMBER <b>LSP-0015</b>
17. <input type="checkbox"/> The following fees are submitted: <b>Basic National Fee (37 CFR 1.492(a)(1) - (5)):</b>		<u>CALCULATIONS</u> <u>PTO USE ONLY</u>	
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....		\$1,040.00	
International preliminary examination fee (37 CFR 1.482 not paid to USPTO but International Search Report has been prepared by the EPO or JPO).....		\$890.00	
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Surcharge of \$130.00 for furnishing the oath or declaration later than <u>20</u> <u>30</u> months from the earliest claimed priority date (37 CFR 1.492(e)).			
Claims	Number Filed	Number Extra	Rate
Total claims	<b>2- 20 =</b>	<b>0</b>	X \$18.00
Independent Claims	<b>2- 3 =</b>	<b>0</b>	x \$84.00
Multiple dependent claims(s) (if applicable)		+ \$280.00	
<b>TOTAL OF ABOVE CALCULATIONS = \$890.00</b>			
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by $\frac{1}{2}$ .			
<b>SUBTOTAL = \$890.00</b>			
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<b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b>			
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<b>Steven B. Samuels</b> Woodcock Washburn LLP One Liberty Place - 46th Floor Philadelphia, PA 19103 (215) 568-3100		 <b>Steven B. Samuels</b> NAME _____	
37,711 REGISTRATION NUMBER			

10048095 11 APR 2002  
Rec'd PCT/PTO 11 APR 2002

DOCKET NO: LSP-0015

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

**In Re Application of:**

**Rudiger, et al.**

**Serial No.: 10/048,095**

**Group Art Unit: Not Assigned Yet**

**Filing Date: January 24, 2002**

**Examiner: Not Assigned Yet**

**For: METHOD FOR POWER OPTIMIZATION IN VEHICLE/TRAIN HAVING AN EFFICIENCY THAT DEPENDS ON THE OPERATION POINT**

**WITHDRAWAL AS ATTORNEY AND  
CHANGE OF CORRESPONDENCE AND MAINTENANCE FEE ADDRESS**

The following attorneys or agents apply to withdraw in the above identified application:

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John E. McGlynn	Registration No. 42,863	Sharon Fenick	Registration No. 45,269

**DOCKET NO: LSP-0015****- 2 -****PATENT**

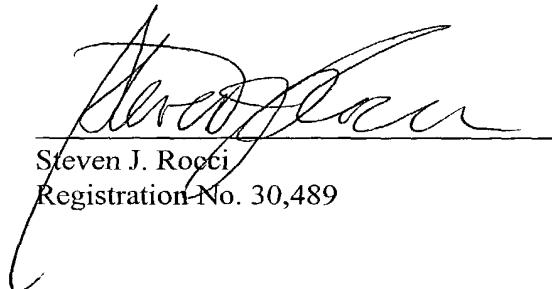
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The undersigned attorney is authorized to sign on behalf of the above-listed attorneys each of whom are attorneys at the firm Woodcock Washburn, LLP.

Date: 4/9/02



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531 Rec'd PCT/ 24 JAN 2002

Method for power optimization in a vehicle/train having an efficiency that depends on the operating point

Description

5

The invention relates to a method for power optimization in a vehicle/train according to the preamble of claim 1.

10 During the planning of journeys and the drafting of schedules for rail traffic, time reserves for unforeseen events and adverse operating conditions are included in the plans. Since, during real journeys, the operating conditions are typically more favorable than  
15 those assumed during planning, the time reserves created by this are available for other purposes. A particularly practical use of the time reserves resides in the saving of power by means of a suitable travel mode.

20

Previously known and used methods for power minimization are mostly based on the assumption that a travel mode comprising the constituents maximum acceleration - travel at constant speed - coasting -  
25 maximum retardation is optimum in power terms. In this case, the mechanical tractive power which is needed to accelerate the vehicle is minimized. For verification, a linear dynamic train model is used, in particular no account being taken of any term which describes the  
30 quadratic relationship between speed and travel resistance.

In DD 255 132 A1, this basic assumption is expanded by subdividing a total route into a number of sections, so  
35 that in each section the slope resistance of the route is constant.

In EP 0 467 377 B1, the subdivision of the overall route into a number of sections is introduced in such a way that in each section the permissible maximum speed is constant. The travel mode comprising the 5 constituents maximum acceleration - travel at constant speed - maximum retardation is repeated in each section. Coasting is therefore dispensed with.

EP 0 755 840 A1 does not describe a practical method 10 for power optimization but instead explains a general system structure with which power optimization can also be implemented. A cycle comprising acceleration - travel at constant speed - retardation and braking is listed as an example.

15 The invention is based on the object of specifying an improved method for power optimization with regard to the time reserves included in the planning of a schedule of a vehicle/train.

20 This object is achieved, in conjunction with the preamble, by the features specified in claim 1.

The advantage which can be achieved by the invention is 25 in particular that, by taking into account the dependence of the vehicle efficiency on the operating point in the optimization algorithm, instead of the mechanical tractive power, it is the power primarily used, such as the electrical power in electric rail 30 vehicles, which is minimized.

An advantageous refinement of the invention is identified in the subclaim.

35 Further advantages of the proposed method emerge from the following description.

The invention will be explained in more detail below using the exemplary embodiments illustrated in the drawing, in which:

5 Figs. 1, 2 show characteristic maps of the power loss of typical electric locomotives,

Fig. 3 shows an exemplary speed plot at an assumed constant vehicle efficiency and  
10 maximum speed, and

Fig. 4 shows an exemplary optimum speed plot taking into account the dependence of  
15 the vehicle efficiency on the operating point, and maximum speed.

The vehicle efficiency is the ratio between the tractive power provided - the output power - and the input power needed for this, in particular the electric  
20 power, which is drawn by an electric locomotive via a pantograph. The difference between the input power and the output power is the power loss of the vehicle.

The invention provides for the dependence of the efficiency on the operating point to be included in the power optimization or for power optimization with regard to the time reserves included in the planning of a schedule of a vehicle/train, since a calculation with an assumed constant efficiency represents only a poor  
30 approximation to the actual optimum. In this case, the problem of power minimization is formulated as a mathematical optimization problem and is solved by a suitable, generally known optimization algorithm.

35 Optimization algorithms which are suitable for the proposed method are known, for example, from Papageorgiou: Optimierung [Optimization], Chapters 10, 19 and in particular 20, Oldenbourg Verlag, 1996.

The dependence of the efficiency on the operating point can be taken into account via a function of the efficiency or the power loss as a function of important 5 influencing variables, such as in particular the tractive force and/or speed and/or temperature. For this purpose, Figures 1 and 2 show characteristic maps of the power loss of typical electric locomotives. Such a three-dimensional characteristic map of the power 10 loss as a function of the tractive force and the speed is a typical option for representing the dependence of the efficiency on the operating point.

Fig. 3 shows, as a traveling diagram, an exemplary 15 distance/speed plot - see the continuous curve - with an assumed constant vehicle efficiency and maximum speed in the individual route sections - see the dashed curve. The travel mode illustrated is composed of the known constituents, these being used repeatedly in each 20 subsection with constant speed limitation. These known constituents are essentially maximum acceleration, coasting and braking in the first section, followed by "travel at constant speed" in the slow-travel section, followed by maximum acceleration and the change between 25 coasting and braking to a standstill.

Fig. 4 shows, in comparison with this, as a travel diagram (and determined in accordance with the characteristic map according to Fig. 1) an exemplary 30 optimum speed plot - see continuous curve - taking into account the dependence of the vehicle efficiency on the operating point and maximum speed - see the dashed curve. The optimum travel mode illustrated differs considerably from travel modes which can be determined 35 with previously known methods (see Fig. 3). In particular, in the exemplary embodiment illustrated, use is made of reduced acceleration, which merges smoothly into the braking.

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Patent Claims

1. A method for the power-optimal travel mode of a vehicle/train, the time reserves for unforeseen events and adverse operating conditions included when planning schedules being available for saving power by means of a power-optimal travel mode, wherein the dependence of the vehicle efficiency, defined as the quotient of the tractive power provided - the output power - and the input power needed for this purpose, on the tractive force and/or speed and/or temperature is used for the purpose of optimizing the power with regard to the time reserves.
2. A method for the power-optimal travel mode of a vehicle/train, the time reserves for unforeseen events and adverse operating conditions included when planning schedules being available for saving power by means of a power-optimal travel mode, wherein the dependence of the vehicle power loss, defined as the difference between the input and the output power, on the tractive force and/or speed and/or temperature is used for the purpose of optimizing the power with regard to the time reserves.

Method for power optimization in a vehicle/train having  
an efficiency that depends on the operating point

Abstract

A method for power optimization in a vehicle/train, using time reserves included when planning a schedule, is proposed. In order to achieve a power-saving travel mode with the aid of an optimization algorithm, the dependence of the vehicle efficiency or the power loss on the operating point is taken into account.

Relevant figure: Fig. 1

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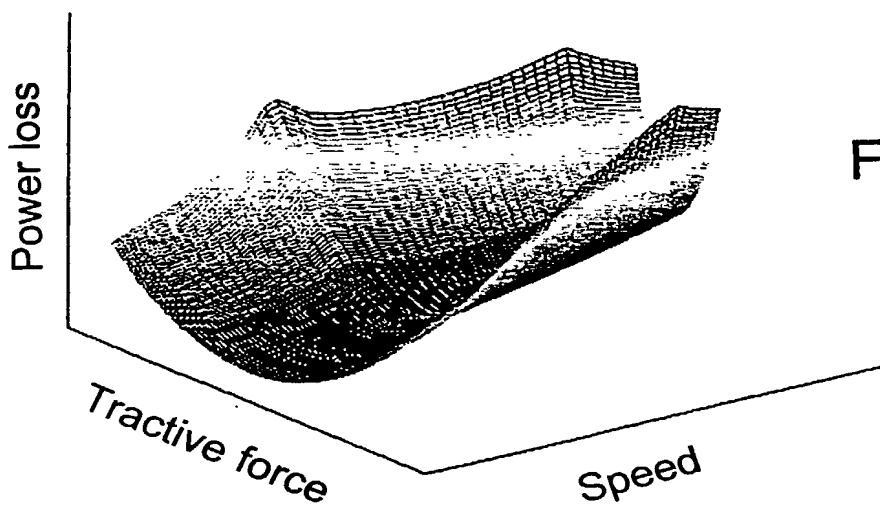


Fig. 1

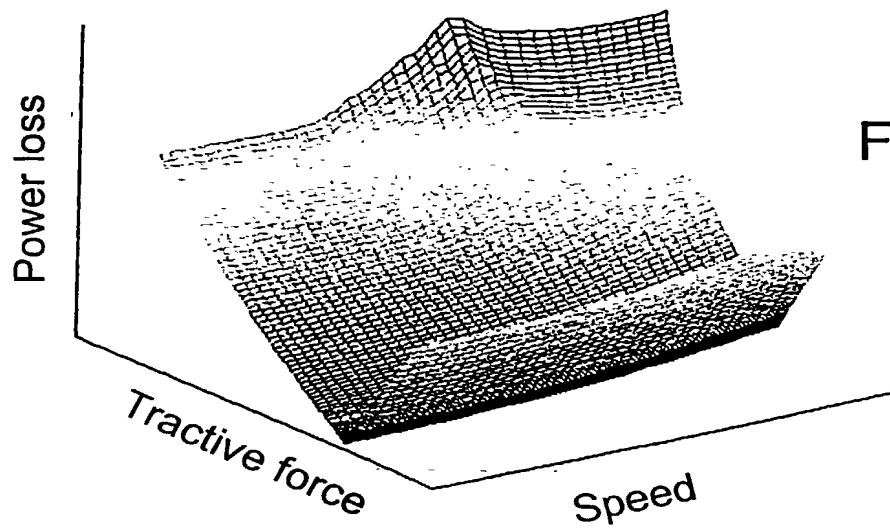


Fig. 2

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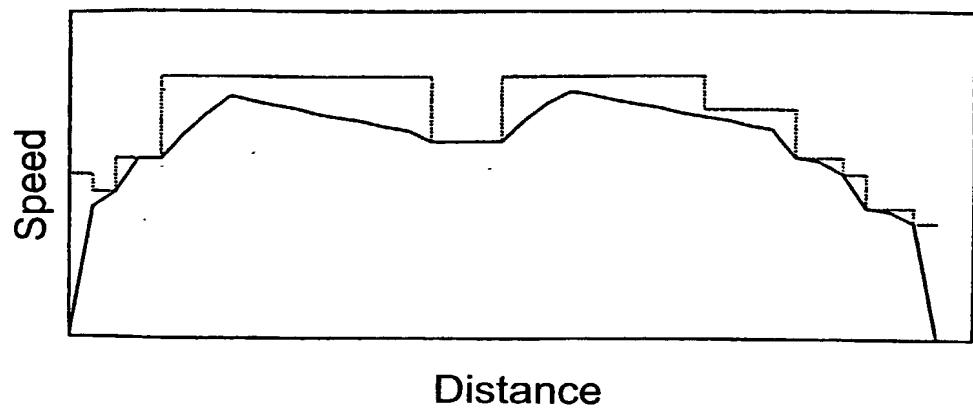


Fig. 3 ( Prior art )

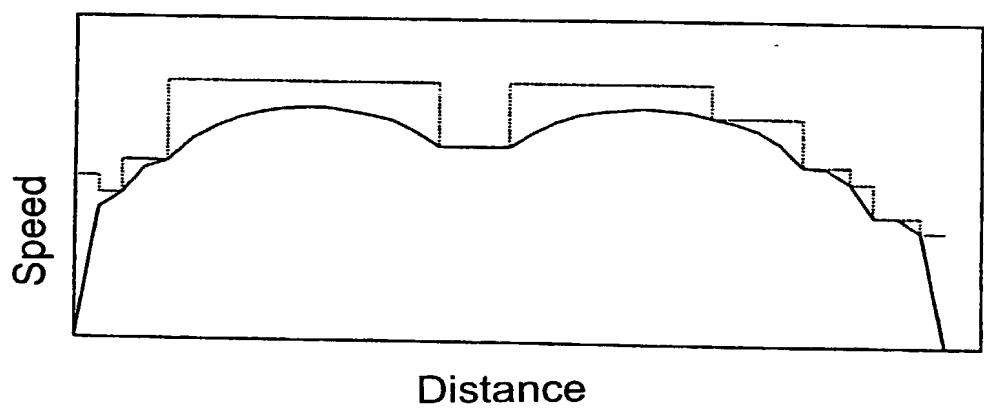


Fig. 4

Approved for use through 8/30/98, OMB 0651-0032  
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I believe I am the original, first and sole inventor (if only one  
name is listed below) or an original, first and joint inventor (if  
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des Vertrags über die Zusammenarbeit auf dem Gebiet des Patentwesens (PCT) /  
as United States Application Number or PCT International Application Number: **PCT/EP00/07152**

und am / and was amended on (if applicable) **3 September 2001** abgeändert (falls zutreffend).

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(Number) (Nummer)	(Country) (Land)
<b>DE 199 35 351.4</b>	<b>Germany</b>

I hereby claim foreign priority under Title 35, 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

(Filing Date: day/month/year) (Anmeldetag : tag-monat/jahr)	Priority Not Claimed Priorität nicht beansprucht
<b>29 July 1999</b>	<input type="checkbox"/>
	<input type="checkbox"/>

Ich beanspruche hiermit Prioritätsvorteile unter Title 35, US-Code, § 119(e) aller US-Hilfsanmeldungen wie unten aufgezählt.

(Application No.) (Aktenzichen)	(Filing Date: day/month/year) (Anmeldetag : tag-monat/jahr)
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(Application No.) (Aktenzichen)	(Filing Date: day/month/year) (Anmeldetag : tag-monat/jahr)	(Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)
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